STUDENT ANESTHETIST LEARNING CURVE PERSPECTIVES ON SCIATIC

NERVE LOCALIZATION PROFICIENCY — A PILOT STUDY

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ABSTRACT

Regional anesthesia techniques are invaluable tools in the armamentarium of ***anesthesia*** practitioners. Utilization of visual and palpable ***anatomical landmarks*** in localizing deep-seated peripheral nerves has long been the mainstay of ***regional anesthesia***. Accurate placement of local anesthetics is imperative to obtaining successful neural blockade. Disagreement exists concerning the utility of a peripheral nerve stimulator in nerve sheath location. Regardless of the technique used, ***anatomical landmarks*** and underlying structures need to be fully understood. Very little research exists addressing how best to instruct ***anesthesia students*** in regional nerve blockade. In this study, McAuliffe s (1993) model for advanced nursing practice education was used as a theoretical framework which describes the fact that multiple representations, or multiple attempts are required to obtain a level of proficiency. In this study, a student registered nurse anesthetist (SRNA) attempted to locate the sciatic nerve using ***anatomical landmarks*** on a ***rat*** model. The data revealed that 15 attempts were required before an appropriate level of proficiency was obtained.

Key Words: **regional anesthesia**, **anatomical landmarks**, **anesthesia**, **student**, **rat**, **sciatic nerve**

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ALAN SCOTT LOVEJOY, RN, BSN, CCRN, CEN, CPAN

THESIS

Presented to the Graduate School of Nursing Faculty of

the Uniformed Services University of the Health

Sciences in Partial Fulfillment of the

Requirements for the

Degree of

MASTER OF SCIENCE

UNIFORMED SERVICES UNIVERSITY OF THE HEALTH SCIENCES

October 2000

PREFACE

This research was conducted in order to establish how many attempts are required by a student nurse anesthetist to obtain a level of proficiency in localizing the sciatic nerve of a rat.

DEDICATION AND ACKNOWLEDGEMENT

To my eternal companion Tracy whose encouragement and patience through difficulty was instrumental in my completing this work. To my mother and son Joshua, whose struggles through life and death gave me the strength to overcome my own weaknesses. To Rachel, Scott, and Amanda who believed in me, their father.

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CHAPTER I : INTRODUCTION

Background

Regional Anesthesia

After Koller introduced cocaine as a topical local anesthetic in 1884 (Singler, 1983), active and widespread experimentation of varied regional anesthesia techniques ensued. In 1884, Hall pioneered early work in this area with their report of the first regional anesthetic performed by directly blocking the transmission of peripheral nerves. Regional nerve blockade as an alternative to general anesthesia increased in popularity and was firmly established with the publication of Gaston Labat s classic text in 1922. In practice, regional anesthesia continued largely in the tradition of Labat, utilizing anatomical landmarks and having a profound influence on the performance of neural blockade for nearly 30 years (Singler, 1983). The early work of Accardo and Adriani (1949) recommended discrete injections of several nerves located within nerve sheath plexuses, introducing a new concept in regional nerve blockade.

It was not until 1957 that the importance of a neurovascular sheath was realized and used in brachial plexus blockade (Singler et al., 1983). The first report of actual use of the sheath to promote the spread of anesthetic around the nerves was made by Burnham in 1958. Eather (1975) was the first to describe a sheath type neural blockade for regional anesthesia in pediatric patients, a technique he elaborated on some years later. Winnie (1970) refined this nerve sheath concept by completely encircling the sheath barrier in order to prevent the escape of local anesthetics.

Current practice regarding neural blockade (i.e., brachial plexus blockade) in the operating suite is to typically use a single injection, giving sufficient time to completely

encircle all structures within the sheath in order to block conduction of neuromuscular impulses. Many practitioners use peripheral nerve stimulators in locating peripheral nerve sheaths (i.e., brachial plexus).

Peripheral Nerve Stimulator (PNS)

Accurate placement of a local anesthetic in immediate proximity to a peripheral nerve is essential for successful nerve conduction blockade (Montgomery, Raj, Nettles, & Jenkens, 1973), and correct placement requires familiarity with regional anatomy and anatomical landmarks (Brown, 1985; Sethna, 1992). Pither, Raj, and Ford (1985) stated that success, even with the use of a nerve stimulator, requires sound knowledge of the regional anatomy to be blocked, innervation of the muscle groups involved, and learning the correct techniques of peripheral nerve stimulation. He continued by stating that failure of nerve blockade using a PNS is usually due to incorrect techniques of nerve stimulation.

Difficulty arises when there is anatomical variation, seen particularly in developing children and obese patients where landmarks are difficult to localize in the varied depths of deep-seated nerves (Bosenberg, 1995). Seeking paresthesias as a sign of accurate needle placement requires the patient s cooperation that is unlikely to be anticipated in a frightened child.

An alternate technique, using a peripheral nerve stimulator (PNS) attached to a probing needle, allows for localization of a nerve by electrical stimulation of its motor component. One might conclude that familiarization with anatomical landmarks, a cooperative patient, and a technique free of undue discomfort would be the consummate

formula in providing the ideal regional nerve blockade.

The PNS technique has been considered especially useful in the anesthetized patient since practitioners are unable to obtain critical, subjective information from patients. However, the inability to establish and discern paresthesia, illicit pain while actually touching nerves, and the potential cutaneous damage from multiple attempts are but a few of the potential complications to eliciting neural blockade on anesthetized patients.

Children, or otherwise uncooperative patients are often anesthetized before regional anesthesia is performed. Post-operative pain control has shown to be problematic in these patient populations. Some of the most painful operative procedures in pediatric orthopedic practice are on the lower limbs, and regional anesthesia has proven to be beneficial in post-operative pain control (Arthur & McNicol, 1986).

The utilization of a PNS does not ensure unblemished success, even with those practitioners that tout this technique as their preferred method. Davies and McGlade (1993) conducted a study where only 44 of 100 peripheral blocks were successful when utilizing the paresthesia method, yet when a PNS was used, 95 of 100 blocks were successful. He further states that no successful blocks were realized when local anesthetics were injected in a blind fashion. His findings suggested that either eliciting paresthesia or a positive response to a peripheral nerve stimulator carried a high correlation to subsequent successful block, and that the use of the nerve stimulator provided a more consistent and reliable technique for nerve localization. Nonetheless, perfection is not achieved with either method.

In contrast to the above noted successes, Smith (1976) found the PNS to be

cumbersome and ineffectual in substantiating the claims of greater success with its use. He stated that there were no significant differences in their study to the number of needle insertions required for location using a stimulator or paresthesia for the sciatic-femoral block. The overall success rate was 47%, but considering the non-stimulator group alone with supplemental ulnar nerve block, the success rate was 75%. He did state that the use of a PNS for location of nerves appeared to be especially helpful in the drowsy or uncooperative patient. But, it was hoped that the stimulator would prove to be a useful teaching device in aiding nerve location. His comparison of the two methods for location did not confirm this. He concluded that the stimulator is not a useful adjunct for nerve location, except in those patients who are unable to cooperate in eliciting paresthesia.

Anatomical Landmarks

Successful neural blockade typically requires an extensive anatomical knowledge base, as well as palpating known bony and muscular landmarks.

In the approach of Labat, the patient is placed in the lateral decubitus position with the lower leg extended and the upper leg, the one to be blocked is flexed. A line is drawn from the posterior superior iliac spine to the greater trochanter of the femur. Another line is drawn from the greater trochanter to the coccyx. The original line is bisected, and the perpendicular line is drawn from that point to the second line. The point at which it intersects the second line is the point of the needle insertion. Typically, a 22-gauge needle is advanced perpendicular to the skin until it strikes the bone. It is possible for the needle to pass through the sciatic notch without either encountering bone or causing a paresthesia. In that case, the needle is redirected in a cephalad direction until

bone is encountered. Paresthesia is then sought utilizing a gridlike approach.

An alternative to seeking paresthesia in pediatric patients is to use the nerve stimulator as stated in the previous section. Alifmoff and Cote (1993) noted that a nerve stimulator is not a substitute for anatomic knowledge, but is a useful adjunct. Its usefulness is also disputed by Smith (et al., 1976).

Utilizing anatomical landmarks in isolating peripheral nerves and their location has been the mainstay of regional anesthesia for many years. However, regional anesthesia techniques may be underutilized because individual anesthesia practitioners may not be confident in their performing regional anesthesia techniques. A reasonable question arises concerning the adequacy of our teaching new practitioners the art of regional anesthesia.

Teaching Techniques

Regional blocks have limitations. These techniques require skill and practice in their performance, particularly on smaller infants. This skill may not be present in all practitioners (Rice, 1996). Additionally, in order to properly place a regional block, two people are typically needed as the procedures tend to be a three-handed maneuver. The luxury of having two anesthetists available to provide one regional block is not always possible.

Regional anesthesia techniques are learned skills. The fact that all anesthesia providers must perfect their skills in order to provide this advanced level of analgesia is well-documented (Smith et al., 1976; Smith & Allison, 1987). The conventional anatomically based technique used for many years has been associated with varying

degrees of success (Smith et al., 1976).

Sciatic nerve blockade has earned a reputation among many anesthetists as being both technically difficult and time consuming to perform, often with disappointing success rates (Smith & Allison et al., 1987). The efficacy and utilization of the modern PNS has been debated since its introduction and utilization in the early 1960 s (Smith et al., 1976).

Research has demonstrated that trainees in anesthesia are noticeably more willing to attempt sciatic nerve blockade in unconscious, rather than conscious patients. This appears to be linked to the lack of psychological pressure on the trainee that otherwise occurs with awake, apprehensive patients (Smith & Allison et al., 1987).

Performing regional anesthesia on anesthetized patients is not typically an anesthetist s first choice since the anesthetist is unable to elicit a verbal or sensory response from the patient. It might seem reasonable, therefore, to encourage the use of a PNS with unconscious patients when teaching new residents to perform sciatic nerve blockade. Residents might acquire high degrees of practical ability, and therefore confidence in relaxed environments before attempting the blockade on conscious subjects. However, this mode of teaching residents requires a comprehensive, time consuming hands-on training regimen, as well as a well-versed knowledge of anatomical landmarks. The time required for this level of training might be a limiting factor in providing that instruction.

Whether or not to perform a regional technique depends not only on the resident s level of confidence and expertise, but the patient s preferential input. In a study performed by Fanelli, Casati, Garancini, and Torri (1999), 3996 peripheral nerve blocks

were performed successfully over a six-month period. Despite a 90% blockade success rate, only 74% of the patients would request the same anesthetic procedure if they underwent another surgery. It was noted that this was mainly because of the discomfort experienced during block placement. Additionally, it was noted that none of these patients received sedative premedication. Fanelli (1999) stated that acceptance of a painful procedure, such as the multiple injection technique of a sciatic nerve block, might improve if deeper levels of sedation were given.

Another concern in teaching new residents neural blockade techniques lies in the inherit question regarding the number of attempts to achieve proficiency. Will four or five successful attempts sufficiently prepare the resident to provide subsequent successful neural blockade; or will twenty, thirty, or even fifty attempts be required?

Statement of the Problem

Nurse anesthetists and anesthesiologists in many settings, including the remote practices of rural hospitals and distant duty stations of the military provide regional anesthesia procedures. The problem is how best to teach anesthetists proper placement of sciatic nerve blockade, as well as other equally difficult and potentially dangerous regional nerve blocks. Performed properly, regional techniques are an invaluable part of the anesthetist s armamentarium. Trainees require multiple attempts at sciatic nerve blockade while in a training program before proficiency is obtained.

If new residents can be taught proper techniques, there may be a decreased risk of tissue damage from digging and searching for a nerve sheath; decreased nerve damage from needle exposure; and increased confidence on the part of the new resident as

successes are realized. This was vividly presented in a study where 223 sciatic nerve blocks were performed by students with little or no practical experience in regional anesthesia resulting in a 98% success rate with a PNS (Bosenberg, 1995). Nevertheless, how many attempts are required in an anesthetist s typical clinical setting before proficiency is obtained?

Certified Registered Nurse Anesthetists (CRNAs) continue to provide over 65% of all anesthesia across the United States (American Association of Nurse Anesthetists, 1997), and it is extremely important for these practitioners to perfect these skills. After an extensive search of MEDLINE and CINAHL (October 1997 through May 2000), there is limited published information concerning how to actually teach regional anesthesia techniques to CRNAs and anesthesiologists. More specifically, no information was obtained addressing the number of attempts required before a level of proficiency is obtained.

Advancements in technology have been made over the last several decades, improving the practitioner s ability to perform all aspects of anesthesia practice. Rapid change is one of the most striking features of our time. A large part of the medical knowledge we possess at the end of our apprenticeship in training has become obsolete within ten years. No specialist can remain competent without taking energetic steps to keep in touch with the growing edge of the specialty (Clark, 1992).

Improved nerve sheath locating technology is already available (Raymond, Abrams, Raemer, Philip, & Strichartz, 1992). As future advancements are developed, nurse anesthetists need to be prepared to use these new techniques in overcoming the continued challenges that face them in their practice.

Purpose Statement

The purpose of this pilot study was to describe how many attempts were required a newly trained student nurse anesthetist to locate the sciatic nerve accurately on a rat employing anatomical landmarks.

Research Question

How many attempts at sciatic nerve blockade on a rat are required of a student nurse anesthetist, using only anatomical landmarks, to become proficient in locating the sciatic nerve.

Conceptual and Theoretical Framework

The framework for this study was based on a model for advanced nursing practice education developed by McAuliffe (1993). McAuliffe describes nurse anesthesia education as a progressive process in which, over time, the nurse anesthesia student may obtain required knowledge and skills. The following is a summary of the model (see Figure 1).

Nurse anesthesia students acquire the needed didactic (declarative) knowledge with practical (procedural) knowledge on a continuum of learning. Didactic information is typically gained in a lecture setting. Hands-on practicums combine declarative knowledge with procedural knowledge.

McAuliffe describes the didactic, or lectured information as declarative knowledge, or the know what , know that   portion of the Information Stage. This

declarative knowledge is combined with the procedural knowledge, or the know how side of the Information Stage. As students continue through the learning continuum, they enter the Novice Stage. This is when conditional knowledge is acquired, the know when part of the continuum.

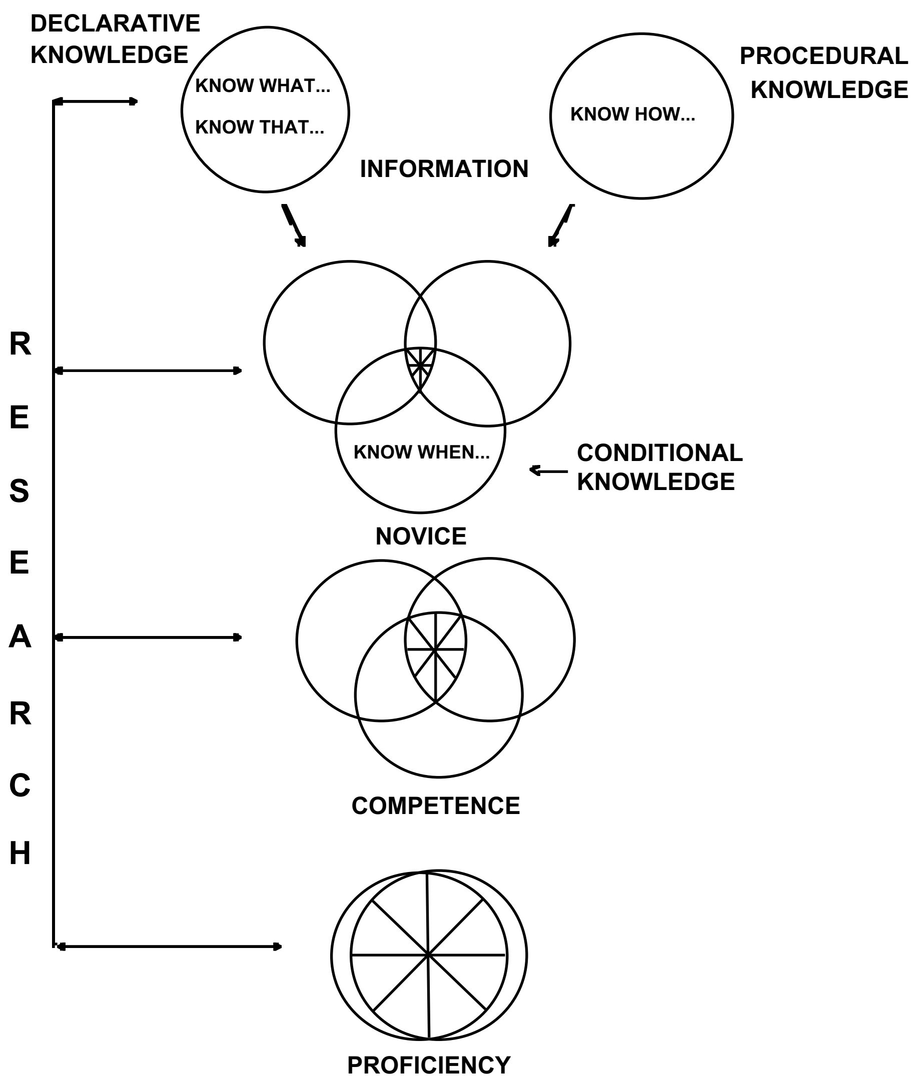

Figure 1.

<u>Advanced Nursing Practice Model (with permission from Dr. McAuliffe, Ph.D.)</u>.

<u>Information Stage</u>

McAuliffe (1993) states that it is far more efficient in the learning process to learn through the aid of an instructor and instructional manual than to flounder through trial-and-error. Nurse anesthesia students typically have a considerable amount of didactic training in their first phase of education prior to using their gained knowledge in clinical settings. During this first stage of learning, or the Information Stage, the integration of classroom lectures and clinical laboratory setting demonstrations occur. This learning is temporarily reinforced by traditional examinations.

<u>Novice Stage</u>

The next stage of learning, or the Novice Stage, is where students have more clinical instruction. Clinical instructors help students in transitioning away from the strict didactic setting and help students integrate previously learned material from the classroom into the rigors of the clinical setting.

It is during this stage that students integrate three types of knowledge; the knowledge of theory (declarative), the knowledge of practice (procedural), and contextual knowledge (conditional). McAuliffe (1993) makes a valuable point in stating that only by integrating these knowledge bases through experiential learning can the students learn the art and science of nurse anesthesia. It is also during this Integration Stage that students begin to formulate and execute plans of action.

<u>Competence Stage</u>

An increasing overlapping of theory and practice pictorially shows the next stage, or the Competence Stage. This is where students have stepped beyond simple, independent reasoning and have reached a level of knowledge that through their own

reasoning they can formulate, implement, and evaluate a proper and safe anesthetic plan of action (McAuliffe, 1993).

It is during this stage that students are encouraged by clinical instructors, peers, and experienced anesthetists to examine and reflect upon their own thinking. Initially, they are checked, and at times challenged why they have chosen a certain problem solving strategy. As they increase in their clinical experiences, they are actually encouraged to reflect even more on their thought process and to make appropriate modifications as necessary (McAuliffe, 1993).

Proficiency Stage

In the final stage, or the Proficiency Stage, students find themselves challenged with increasingly difficult tasks to test their understanding as clinical instructors continue to challenge their thought processes. Students at this point are expected to appropriately verbalize their thought processes. It is only through experiences with actual cases, or case-based instruction, that the nurse anesthesia students can integrate the necessary declarative, procedural and conditional knowledge bases required for the practice of nurse anesthesiology. The purpose of instruction is moved from abstract learning theory to applying knowledge in practice. It is through reflecting and deliberating on problematic situations that students appropriately learn the necessary skills to practice (McAuliffe, 1993).

The Seven Themes

Seven themes weave their way through the four stages of McAuliffe s (1993) advanced nursing practice model. These themes influence the learning process.

1. Theme One: Avoidance of oversimplification and over-regularization. Making salient those ways that knowledge is not simple and orderly as it might first seem in the introductory stage.

2. Theme Two: Multiple representations. It is imperative that a student is exposed to multiple representations of a particular topic, developed from different vantagepoints.

3. Theme Three: Centrality of cases. Because there is great variability from case to case regarding what is relevant and in what patterns of combination, advanced practice nurses must have experience with a large number of cases.

4. Theme Four: Conceptual knowledge is knowledge in use. Only so much can be learned in the abstract. Therefore, in advanced practice nursing weight must be given to learning about new cases by examination semblance with past cases.

5. Theme Five: Schema assembly (from Rigidity to Flexibility). Emphasis must be shifted from retrieval of intact, rigid, knowledge structures to assembly of knowledge from different conceptual and precedent case sources to adaptively fit the situation at hand.

6. Theme Six: Non-compartmentalization of concepts (multiple). Rather than relegating cases to separate compartments, a strategy frequently encountered in didactic education, students must strive for multiple interconnectedness of cases and concepts along multiple conceptual and clinical dimensions.

7. Theme Seven: Active participation. Knowledge cannot be handed to the learner. Prior codifications of knowledge are likely to misrepresent. There must be active learner involvement in knowledge acquisition, accompanied by opportunistic guidance by expert mentors.

Summary of Model

This seven-staged model depicts how nurse anesthesia students begin their learning in the Information Stage (McAuliffe, 1993). In this stage of fragmented instruction, the aim is developing students declarative and procedural knowledge base that is analogous to learning the basic and applied sciences of the profession. During the Information Phase, students are learning facts and procedures with little or no clinical experience to use as a bottom-up frame of reference. Clinical education provides opportunities to develop conditional knowledge that allow students to apply declarative and procedural knowledge; aspects of which often must be re-learned experientially. This occurs only through case-based instruction, with its seven themes (depicted by the crossed lines at the center of the circles in Figure 1).

Through case-based instruction, students learn to draw upon their three knowledge bases to develop cognitive flexibility -- adapting their knowledge to tasks involving new situations. To develop proficiency as a nurse anesthetist, students must have experience with a large number of cases, and expert mentors must guide these cases (McAuliffe, 1993).

Theme Two, or Multiple Representations, has particular relevance to this study as it provides the theoretical basis for students to learn sciatic nerve blockade from different perspectives and multiple attempts in achieving a level of proficiency (McAuliffe, 1993).

Definitions

1. Conceptual definition of usage of anatomical landmarks. One aspect of multiple representation in learning a new skill.

Operational definition of usage of anatomical landmarks. A nurse anesthesia student who administers sciatic nerve blockade in rats using anatomical landmarks.

2. Conceptual definition of accuracy. The correct placement of injected solution.

Operational definition of accuracy. After injection of a Niagra Sky Blue tainted solute, a dissection of a post-mortem rat sciatic nerve will be performed noting the proximity of the tainted solute to the sciatic nerve.

3. Conceptual definition of a student nurse anesthetist. A student nurse anesthetist is an advanced practice nurse who is specializing in anesthesia. Nurse anesthetists provide, or participate in the provision of advanced specialized nursing and anesthesia services to patients requiring anesthesia, respiratory care, cardiopulmonary resuscitation, and/or other emergency, life-sustaining services wherever required (International Federation of Nurse Anesthetists, 1990).

Operational definition of a student nurse anesthetist. A nurse anesthesia student with limited exposure to clinical anesthesia practice will perform all sciatic nerve injections on a rat.

Assumptions and Limitations

Assumptions

1. Anesthetists currently provide regional anesthesia with and without the use of a PNS. However, in teaching the new anesthetist proper techniques, the use of a PNS may be useful.
2. Knowledge of anatomical landmarks is required of the anesthetist in providing regional neural blockade.

3. The nurse anesthesia professional is interested in progressive technology regarding new regional anesthetic techniques.

Limitations

1. This animal study cannot be generalized to a human model.
2. All rats utilized were post-mortem.
3. Only one student, the author of the study, attempted to locate the sciatic nerve.
4. There was no instruction on this technique. The procedure was invented for this pilot study.

Summary

In this Chapter, the historical development of regional anesthesia focusing on the particularly difficult sciatic nerve blockade was presented. An introduction to peripheral nerve stimulators and anatomical landmarks were given with regards to their use in regional anesthesia. The appropriateness of training anesthesia residents in regional anesthesia, especially those in rural hospitals and the remote duty stations of the military was noted. McAuliffe s (1993) model for advanced nursing practice education was presented, as well as its applicability to this study. McAuliffe s Theme Two, or Multiple Representations, has particular relevance to this study as it provides a theoretical basis for students learning sciatic nerve blockade from different perspectives, as well as requiring multiple attempts to achieve an appropriate level of proficiency. The question arises as to how many attempts are required to obtain a level of proficiency. This study will make objective observations of a nurse anesthesia student s learning curve in performing the

technical skills of a sciatic nerve blockade on a rat. The next chapter details a review of the literature.

CHAPTER II : REVIEW OF THE LITERATURE

Introduction — A Historical Perspective

Koller opened a new world of pain management with his 1884 report of the local anesthetic properties of cocaine. In 1885, Corning introduced the theoretical possibility of epidural and spinal anesthesia by injected cocaine in the thoracic spine of a dog (Singler et al., 1983). Regional anesthesia was used extensively in pediatric patients, beginning with Bier s 1899 report of a spinal anesthetic on an 11-year-old child. By the 1950s, the use of regional blockade was rarely used in infants and children, and infrequently performed in adults because of improved general anesthesia, muscle relaxants, and modern inhalation agents. Additionally, many physicians believed that children suffered less pain than adults suffered, and therefore did not require postoperative analgesia (Rice et al., 1996).

By 1975, Eather noted that regional anesthetic techniques were underutilized in pediatric patients in the United States. He gave three major reasons for this fact. He explained that the lack of experience, the fear of adverse effects, and the lack of patient cooperation prevented many practitioners from performing regional anesthesia (Eather, 1975).

Then came the 1980s. Given the increased awareness of the benefits of regional anesthesia, a rediscovery of sorts emerged with the adult patient. In the 1990s, increasing expertise in regional anesthesia for adult patients, and the realization that infants and children do suffer pain, increased the use of pediatric regional anesthesia. Even though the lack of cooperation by pediatric patients will never be eliminated, improved sedation agents have allowed more children to receive the benefit of balanced anesthesia. In

pediatric patients, most regional blockade is performed with the primary goal of providing postoperative analgesia. A child awakening without pain is much easier to manage than one who wakes with pain (Rice et al., 1996).

The use of regional techniques in anesthesia practice has increased dramatically for several reasons. The increased usage and acceptance of combined regional and general anesthetic techniques, and the fact that supplementing a general anesthetic with successful nerve blockade allowing pain-free awakening, has assured the validity of pediatric and adult regional anesthesia. This is in contrast to the negative effects of parenteral administration of narcotics postoperatively (Alifimoff et al., 1993).

The use of electrical stimulation to aid the performance of regional anesthesia is not new. Von Perthes described the technique as early as 1912 (Perthes, 1912). Anesthetists utilized various techniques with diverse electrical apparatuses. It is only in the last 35 years, however, that technological developments have produced truly portable battery-operated nerve stimulators. This has led to practical applications of the technique.

Pharmacology and Electrophysiology

Anatomically, if a local anesthetic quickly reaches the circulatory system, its effects can readily cross the blood-brain barrier to cause alterations in CNS function. The earliest symptom is usually circumoral paresthesias, followed by CNS symptoms of lightheadedness and dizziness that progress to both visual and auditory disturbances such as difficulty focusing and tinted fields. Objective signs of CNS toxicity during this time are shivering, slurred speech, and muscle twitching. As plasma levels of local anesthetic continue to rise, CNS excitation occurs and tonic-clonic seizures result. Additional

increases in plasma local anesthetic lead to CNS depression, followed by respiratory depression and arrest. These combined affects ultimately produce cardiac arrest (Alifimoff et al., 1993). The prevention of toxic reactions from the administration of local anesthetics is a function of the total dose administered; the site of administration; the rate of uptake; the pharmacologic alterations in toxic threshold; the technique of administration; the rate of degradation, metabolism, and excretion; and the acid-base status of the patient.

Prior to the middle of the 19th century, nerve fiber conduction was thought to be instantaneous. However, it was later discovered that there is a threshold stimulus that must be applied to a nerve fiber to cause it to propagate a nerve impulse. Below this threshold no impulse is propagated; above this threshold no increase is produced in the impulse.

Location of a peripheral nerve to be blocked in children, particularly in young infants less than a year old can be difficult. Bosenberg (1995) noted that variations exist in the relative depths of key structures used in locating nerves in the growing child. Anatomical landmarks are poorly developed and are difficult to identify through varying thicknesses of tissue in children of different ages, especially in the pre-ambulant infant. Fascial sheets are thinner, and identifying loss of resistance is more difficult. Needle phobia exempts the use of paresthesia to accurately localize a nerve. He states that elicitation of paresthesia requires cooperation and understanding on the part of the patient and cannot be expected of a young infant or frightened child.

Sciatic Nerve Blockade

Brown s text, Atlas of Regional Anesthesia (1992), is used extensively in this detailed explanation of the sciatic nerve block. The sciatic nerve is one of the largest nerve trunks in the body, yet few surgical procedures can be performed with sciatic block alone. It is most often combined with one or more blockade techniques including the femoral, lateral femoral cutaneous, and obturator nerve blockade to produce surgical anesthesia of the lower leg. The blockade is also effective for analgesia of the lower leg and may provide pain relief from ankle fractures or tibial fractures prior to operative intervention.

This form of blockade may be indicated for patients needing analgesia prior to transport for definitive orthopedic surgical repair of lower leg or ankle fractures. There also may be patients in whom it is desirable to avoid the sympathectomy accompanying centroneuraxis blockade (i.e., spinal and epidural blockade), and in these patients sciatic block combined with femoral nerve blockade often allows ankle and foot procedures to be carried out. One group of patients in whom this is often useful are those undergoing distal amputations of the lower extremity, whose vascular compromise is based on diabetes or peripheral vascular disease.

Sciatic nerve blockade in adults typically requires from 20 to 25 milliliters of local anesthetic solution. When this volume is added to required concurrent lower extremity peripheral blockade, the total anesthetic dose can reach the upper end of acceptable dosage range. On the other hand, since uptake of local anesthetics from these lower extremity sites is not as rapid as with epidural or intercostal blockade, the larger mass of local anesthetic may be appropriate in this region.

Placement

The sciatic nerve is formed from L-4 through the S-3 roots. These roots of the sacral plexus form on the anterior surface of the lateral sacrum and are assembled into the sciatic nerve on the anterior surface of the piriform muscle. The sciatic nerve results from the fusion of two major nerve trunks. The medial sciatic nerve is functionally the tibial nerve, which forms from the ventral branches of the ventral rami of L4-5 and S1-3. The posterior branches of the ventral rami of these same nerves form the lateral sciatic nerve, which is functionally the peroneal nerve. As the sciatic nerve exits from the pelvis, it is anterior to the piriformis muscle and is joined by the posterior cutaneous nerve of the thigh. At the inferior border of the piriformis, the sciatic and posterior cutaneous nerves of the thigh lie posterior to the obturator internus, the gemelli, and the quadratus femoris. At this point, these nerves are anterior to the gluteus maximus. Here, the nerve is approximately equidistant from the ischial tuberosity and the greater trochanter. The nerve continues on a downward course through the thigh to lie along the posterior medial aspect of the femur. At the cephalad portion of the popliteal fossa, the sciatic nerve usually divides to form the tibial and common peroneal nerves. Occasionally this division occurs much higher, and sometimes the tibial and peroneal nerves are separate through their entire course. In the popliteal fossa, the tibial nerve continues its downward course into the lower leg, while the common peroneal nerve travels laterally along the medial aspect of the short head of the biceps femoris muscle.

Classic Approach

The adult patient is positioned laterally, with the side to be blocked nondependent. The flexed, nondependent leg supports the patient by placement of the heel of the

nondependent leg opposed to the knee of the dependent leg. The anesthetist is positioned to allow insertion of the needle utilizing anatomical landmarks.

A line is drawn from the posterior iliac spine to the midpoint of the greater trochanter. Perpendicular to the midpoint of this line, another line is extended caudomedially for five centimeters. The needle is inserted through this point. As a crosscheck for proper placement, an additional line may be drawn from the sacral hiatus to the previously marked point on the greater trochanter. The intersection of this line with the five centimeter perpendicular line should coincide with the needle insertion site. Through this site, a 22-gauge, 10-12 centimeter needle is inserted. The needle should be directed through the entry site toward an imaginary point where the femoral vessels course under the inguinal ligament. The needle is inserted until a paresthesia is elicited, or until bone is contacted. If bone is encountered prior to eliciting a paresthesia, the needle is redirected along the line joining the sacral hiatus and the greater trochanter until paresthesia is elicited. During this needle redirection, the needle should not be inserted more than two centimeters past the depth at which bone was originally contacted, or the needle tip will be placed anterior to the site of the sciatic nerve. Once paresthesia is elicited, 20 to 25 milliliters of local anesthetic is injected.

Potential Problems

In patients with lower extremity injuries, the classic position is sometimes difficult to use. This block can also be long lived, and the patients should be warned of this preoperatively to prevent undue concern postoperatively

Needle Placement

Many regional anesthesia block techniques require the systematic walking of a needle to successfully locate a desired end-point (i.e., cerebrospinal fluid, paresthesia, and nerve stimulation). When this concept is not learned or adhered to, the situation degenerates into a disorganized, uncomfortable shotgun approach, frequently resulting in frustration and failure (Kopacz, 1995).

Kopacz further describes three principles that influence the accuracy of needle placement. The first principle is often the least realized by the beginning resident. For any given change in a needle s angle of entry, as the amount of tissue being traversed in increased, the resultant amount of movement that is made at the target depth is increased proportionally. The second principle appears to be contrary to the first. To effectively walk a needle that has been inserted a significant distance into the body, it is necessary to withdraw the needle a substantial portion of that distance (usually 50%) before it can be effectively redirected. Finally, the third principle is the least significant. The bevel of the needle itself can produce substantial deviation, particularly when large depths of tissue are traversed.

Smith and Siggins (1988) demonstrated that greater accuracy of needle placement can be achieved by the use of a low power peripheral nerve stimulator (PNS) during sciatic nerve blockade. They stated that this should permit the use of smaller volumes and, therefore, higher concentrations of local anesthetic solutions. Accurate needle placement and the use of concentrated solutions should result both in a more rapid onset and in greater duration of nerve blockade. They further state that difficulties in accurate location of the sciatic nerve are usually overcome by significant infiltration of the general

area of the nerve. The use of such volumes imposes narrow limits on the concentration of local anesthetic agents if you are to avoid systemic toxicity.

Accurate placement of the needle in close proximity to the peripheral nerve is essential for a successful nerve blockade. Correct placement requires familiarity with regional anatomy and landmarks. Difficulty arises when there are anatomical variations, particularly seen in developing children. Landmarks can be difficult to localize, and the depth of these nerves can vary greatly. Eliciting paresthesias as a sign of accurate needle placement requires patient understanding and cooperation. This is unlikely to occur in frightened children who are afraid of needles. Nerve stimulators allow localization of a nerve by electrical stimulation of the nerve bundle and is useful when the patient is anesthetized. This is the usual situation in which regional anesthesia is performed in children (Bosenberg, 1995).

A study conducted by Davies and McGlade (1993) suggested that either eliciting paresthesias, or a positive response to a peripheral nerve stimulator is highly correlated with subsequent successful neuromuscular blockade, but that the use of the nerve stimulator provides a more consistent and reliable technique for nerve localization. They noted that a nerve stimulator elicited a motor response in 95 of 100 successful cases. This is in contrast to their elicitation of paresthesias alone where only 44 of 100 patients had a successful blockade.

Smith and Allison (et al., 1987) compared four groups using paresthesias and PNS techniques on both awake and anesthetized patients. Their results suggested that the use of a low-power PNS significantly improved success rates in establishing sciatic nerve blockade. They concluded that these effects presumably resulted from a more accurate

deposition of the local anesthetic agent in relation to the sciatic nerve. They also noted that when sciatic nerve blockade is performed in the conscious patient, it is generally taught that paresthesias should be sought. It is interesting to note that despite often protracted searching for paresthesias, they were only able to elicit a response 39% of the time. These failed attempts were followed with the use of a PNS where they obtained a significantly higher incidence of successful blockade at 90%. The ability to perform sciatic blockade in the anesthetized patient may increase the clinical applications of the blockade, especially for postoperative pain relief. However, in pediatric practice, for example, it is unlikely that an effective sciatic blockade could be performed on a conscious patient. Similarly, many elderly, confused or uncooperative patients might be regarded as unsuitable candidates for this type of anesthesia (Smith & Allison et al., 1987).

In contrast, a study conducted by Smith (et al., 1976) suggested that there were no significant differences in the number of needle insertions required for sciatic nerve sheath location using a stimulator or paresthesias for a sciatic nerve blockade. Sciatic-femoral blockade was more often effective using paresthesias for location than using the stimulator, noting a $p < .05$ in a resident training program. However, Smith noted that stimulator location for nerve blockade to be especially helpful in the drowsy or uncooperative patient. Smith (1976) had hoped that the stimulator would prove to be a useful teaching device, to aid in nerve location for the novice, but their comparison of the two methods for location did not confirm this. The incidence of successful neural blockade in their non-responsive stimulator group of patients was not significantly different from those in whom paresthesias were elicited. Smith (1976) stated only that it

appears that the stimulator is only a useful tool in the location of nerves for regional blockade in patients who are unable to cooperate. Smith (1976) concluded that the stimulator is not a useful adjunct for nerve location, except in those patients who are unable to cooperate in eliciting paresthesias. This contrasting study is offered as an example of the conflicting data provided by clinical researchers of our day.

Finally, techniques for such blocks are well known and are usually free of complications; however, nerve damage can occur. A case report submitted by Bonner and Pridie (1997) notes a case where a successful block was performed, yet the patient sustained a nerve palsy unrelated to the block. No pain or paresthesia were elicited during the procedure, and postoperative analgesia was excellent. However, 24 hours after surgery the patient was noted to have a motor and sensory deficit in the distribution of the sciatic nerve with a marked footdrop. It was later determined that the standard thigh tourniquet with an appropriately applied pressure of 250 mmHg for 24 minutes was the cause of the nerve palsy which lasted nearly 12 months. This surgical complication became an anesthesia complication secondary to its onset of sequelae and should be considered as a differential diagnosis in the case of nerve damage.

Gap in Knowledge

A review of literature showed that there is disagreement on the part of many anesthesia professionals and researchers as to the usefulness of nerve stimulators as an appropriate teaching tool. There appears to be some agreement to its use on the pediatric, combative, and otherwise non-cooperative patients.

Sciatic nerve blockade has earned a reputation among many anesthetists as being

both technically difficult and time-consuming to perform with often disappointing success rates. Sciatic nerve blockade can potentially mask the development of a compartmental syndrome. This is a particular concern of the orthopedic surgeon, especially when pain, an early warning sign of compartmental syndrome is removed by successful blockade (Bosenberg, 1995).

Brown (1992) states that far too often, those unfamiliar with regional anesthesia regard it as complex because of the long list of anesthetics available and the many descriptions of varied techniques. Certainly, unfamiliarity with any subject will make it look complex. Brown also states that it often seems that those recommending the use of nerve stimulators for regional anesthesia do more to impeded the successful use of regional anesthesia than they do in advancing regional techniques.

The primary impediment to successfully using a nerve stimulator in a clinical practice is that it becomes at least a three-handed or two-individual technique. Most anesthesiology practices do not have the luxury of involving an additional anesthetist in performing regional blockade; thus, the idea that a nerve stimulator will somehow allow more accurate placement of the regional block needle eventually results in the decreasing use of regional techniques. Brown (1992) states that despite this fundamental concern about the use of peripheral nerve stimulators for routine regional blockade, in some circumstances a nerve stimulator can be helpful. Again, this is the case when children and adults are already anesthetized when the decision is made that regional block is an appropriate technique, or in those individuals who are unable to report paresthesias accurately.

Brown (1992) brings forth an important point regarding the appropriate caution in

using the nerve stimulator. He states the need to approach nerve blockade as though the nerve stimulator was not going to be used. In other words, as much attention should be paid to the anatomy and technique when using a nerve stimulator as without its use.

There are relatively few indications for regional techniques as the sole method in pediatric patients. The main advantage of regional blockade in an infant or child is postoperative pain relief. This is especially true with ambulatory surgery patients. The delay of discharge after using narcotics, with the resulting drowsiness and possible nausea is a concern of the health care professional. Regional analgesia has been associated with earlier ambulation and discharge, as well as a decreased need for both narcotic and non-narcotic analgesics (Rice, 1996).

With the increasing awareness of the need for adequate operative and postoperative analgesia, regional anesthesia has increased in popularity. Major nerve blockade in children is considered by some to be unnecessarily invasive, but has been found by several authors to provide good analgesia (Bosenberg, 1995). Future technologies like the NerveSeeker described by Raymond (1992), is just one example of an alternate instrument for locating peripheral nerves. Student anesthetists need to be attuned to these constant changes in technology.

Pither (et al., 1985) concluded that the continued popularity of regional anesthesia depends upon the use of techniques that ensure a high success rate. He is one that alludes to the fact that a PNS can aid in achieving success in difficult and complicated nerve blocks, and that it helps the inexperienced practitioner to objectively assess the proximity of needle placement to the nerve.

Unfortunately, very little research has been conducted to determine the most

effective and efficient method of teaching nurse anesthesia residents regional anesthesia. Secondary to the traditional difficulty in location, sciatic nerve blockade was chosen for this study.

Summary

In this chapter, a historical perspective was presented regarding the development of regional anesthesia techniques, its usage, its fall from favor, and its re-emergence as a valuable anesthesia method. This was followed by a pharmacologic discussion regarding local anesthetic toxicity, supported by a detailed explanation of sciatic nerve blockade and its use. A discussion of accurate anesthetic placement with probing needles comparing the use of anatomical landmarks and peripheral nerve stimulator usage ensued. Finally, a discussion was presented regarding the disagreement of the usage of peripheral nerve stimulators; why people do and do not want to use them; and whether or not its use is a valuable tool in teaching anesthesia residents. The lack of research addressing the teaching of regional techniques to anesthesia residents was also noted. Throughout the next chapter, the methods used in this pilot study will be presented.

CHAPTER III : METHODOLOGY

Research Design

This was a descriptive study to account the observations of an inexperienced student registered nurse anesthetist (SRNA) locating the sciatic nerve of a rat, utilizing anatomical landmarks. The SRNA described in throughout this study was the author of the study. Additionally, it was noted how many attempts were required to obtain a level of proficiency in sciatic nerve sheath location. The SRNAs didactic education included a semester-long advanced anatomy course with practical laboratory, as well as semester-long basic and advanced anesthesia principle courses exposing the SRNA to the basics of sciatic nerve blockade. The SRNA received training from a neuroanatomist experienced with rat anatomy experimentation and the specifics of rodent sciatic nerve anatomy, consisting of a full day of instruction. Greene s classic text on rat anatomy was researched and studied by the SRNA. Additionally, the SRNA received animal procedures handling approved by the Laboratory Animal Review Board and the Laboratory Animal Medicine (LAM) department at the Uniformed Services of the Health Sciences (USUHS).

This pilot study was intended to describe the observed learning curve of a student nurse anesthetist in locating a sciatic nerve in a rat, specifically the number of attempts required to obtain a level of proficiency.

Sampling and Setting

A total of 20 adult Sprague-Dawley rats were used for the procedural portion of this pilot study. All rats were post-mortem. A selected, isolated laboratory was identified

for all procedures. The post-mortem rats were procured from a post-graduate study in which hippocampal testing was being conducted. Upon completion of this pilot study, all rats were returned to the post-graduate candidate for disposal. All supplies including gloves, needles, syringes, Niagra Blue dye, razor blades, surgical instruments, magnifying lenses, and other supplies were procured by this investigator.

Measurement Methods

Initially, after reviewing rat anatomy from Greene s classic text (1963), and after receiving additional hands-on training from a neuroanatomist familiar with rat anatomy, an initial dissection was performed and reviewed by the neuroanatomist. Each procured rat was placed on the laboratory bench in order to expose the anatomical landmarks of the hind-quarter. This careful, initial dissection will be done to establish a visual representation of a typical sciatic nerve on a rat, its exact location, and its depth with respect to other nerves, muscles, skin, skeletal structure, and other anatomical landmarks.

In Greene s (1963) classic text, she notes that the sacral plexus in the rat is more limited in the extent of its origin than in man. It is formed by part of the fourth, fifth, and part of the sixth (n. bigeminus) nerve roots. The division of the nerves mentioned above unite in a large trunk, the lumbo-sacral trunk, which runs parallel with the remainder of the sixth lumbar nerve over the ventral aspect of the sacrum and becomes the sciatic nerve in the pelvis minor where it is separated from the pudendal nerve by the superior gluteal artery. Together they run through the deep groove between the dorsal border of the ischium and the root of the tail, as far as the caudal extent of the sciatic notch where

the sciatic nerve enters the thigh. The posterior cutaneous nerve continues in this groove, while the pudendal nerve takes a more medial course through the pelvis.

The approximate average weight of the Sprague-Dawley rats is 500mg. Sciatic nerve blockade on a 70kg adult human requires from 20-25cc of local anesthetic solution (Brown, 1992). An appropriate comparable dose for the 500mg rat would equal 0.14-0.18cc of local solution. A 0.15cc dose of Niagra Blue tainted solution was injected. Of note, it is interesting that the minimal ratio of drug dose to body weight producing a full block of function seems to be the same for rats and humans (Popitz-Bergez, Leeson, Strichartz, & Thalhammer, 1995).

Each rat was placed in prone position with hind-quarters extended. The anatomical landmarks for localization of the sciatic nerve were palpated. A tuberculin syringe with a 26-gauge needle containing 0.15cc of Niagra Blue tainted sterile water was injected at the desired site. After the injection was complete and the needle removed, a careful dissection of the sciatic nerve was performed by the SRNA. Visualization of the localized, deposited Niagra Blue tainted solution was be noted, and a digital picture taken of the deposited solution. These same steps were repeated will all rats. A millimeter ruler was placed in proximity of the nerve to the dump area of solution to determine the accuracy of the solution placement.

Data Analysis

All observed data acquired is graphically described. Additionally, any trends, observations, changes in technique, and other relevant information related to the learning

process is described. An attempt is made to characterize possible future studies, research projects, and clinical bridges to human trials.

Summary

In this chapter, an explanation of the descriptive pilot study was presented. The Sprague-Dawley rats to be utilized, and the methodology of the study were depicted. The purpose of this pilot study was to observe how many attempts were required to reach a level of proficiency. The measurement methods and observations evaluated were explained. The next chapter is a presentation of the actual data collected, as well as the evaluation of that data.

CHAPTER IV : DATA ANALYSIS

Introduction

A secured laboratory environment, as well as all supplies for this pilot study were acquired. Twenty post-mortem adult Sprague-Dawley rats were procured with permission through a post-graduate study (see Figure 2). The SRNA, who is the author of this study, was taught the basics of rat anatomy by a neuroanatomist familiar with rat anatomy. Additionally, the SRNA studied Greene s (1963) classic text describing detailed rat anatomy in order to familiarize with the involved anatomical structures. The first, arbitrarily chosen Sprague-Dawley rat was chosen for the initial dissection of the sciatic nerve (see Figure 3).

Figure 2.

<u>Sprague Dawley Rat (post-mortem) in Laboratory Setting</u>.

Figure 3.

<u>Initial Dissection of Sciatic Nerve</u>.

This dissection was done under the direction of the neuroanatomist in order to assess sciatic nerve location in relation to external anatomical landmarks. All twenty rats received injections made to each sciatic nerve after the isolation of landmarks, followed by dissections of the sciatic nerve noting the dump of tainted injectate in relation to the sciatic nerve. Observations of relative accuracy were noted and documented utilizing a simple objective scale developed for this pilot study. Upon completion of the study, all rats were returned to the post-graduate study investigator.

Sample

At the beginning of the study, a seven-point scale was established in order to assess the placement accuracy of the injectate in proximity of the sciatic nerve. This scale proved useful in making an objective assessment of injectate placement accuracy. This scale is listed in Figure 4.

SCORE	OBJECTIVE DESCRIPTION
1	Injectate greater than 8mm from sciatic nerve
2	Injectate within 8mm of sciatic nerve
3	Injectate within 6mm of sciatic nerve
4	Injectate within 4mm of sciatic nerve
5	Injectate within 2mm of sciatic nerve
6	Sciatic nerve coverage, all injectate in proximity of nerve
7	Complete coverage of sciatic nerve, no stray injectate

Figure 4.

<u>Objective Proximity Accuracy Scale</u>.

A digital camera was procured in order to visually document injectate placement accuracy. All objective information was documented on the above noted accuracy scale, as well as noting whether the injection was performed on the left or right leg (see Figure 5).

All supplies were placed within reach of the SRNA. A solution of sterile water and Niagra Blue was placed in a glass pipette. A tuberculin syringe with a 26 gauge needle was placed into the solution, and 0.15cc of the solution was aspirated into the syringe. All efforts were made to remove any residual solution from the shaft of the 26 gauge needle. The needle and syringe were set aside.

With a gloved hand, a rat was placed in a prone position with the head away from the SRNA. Anatomical landmarks were palpated by the student in order to orient the location of the sciatic nerve (see Figure 6).

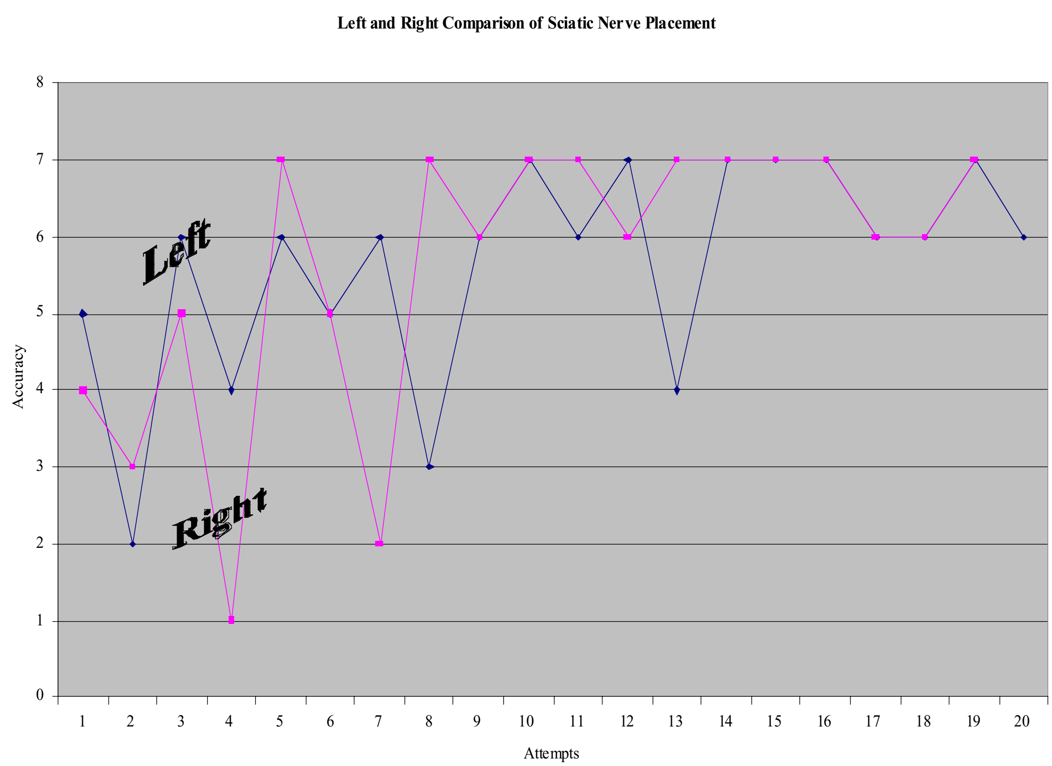

Figure 5.

<u>Left and Right Sciatic Nerve Placement Comparison</u>.

Initially, the trochanter of the femur was palpated in proximity to the tail. It was learned by the student during the initial dissection that this was the likely window to place the injectate. The injection window was enhanced by pulling the lower leg inferiorly. After establishing the probable injection site, the needle of the tuberculin syringe was

placed in position and inserted toward the sciatic nerve. The 0.15cc of solution was carefully injected, and the needle was removed (see Figure 7).

Figure 6.

<u>Palpation of Anatomical Landmarks</u>.

Figure 7.
<u>Injection of Niagra Blue Tainted Solute</u>.

After placement of the solution, a dissection was made by the SRNA to assess the accuracy of placement. A #10 surgical blade was used to make all incisions. First, a cut was made from mid-thoracic region to the insertion of the tail. Second, a cut was made from the same mid-thoracic cut to the lateral aspect of the abdomen. Both incisions were made only deep enough to pierce the hair and skin layer. The hair and skin were then dissected away from the superficial musculature. The dissection continued with removing the gluteus and biceps femoris muscles. All adductor, obturator, and gracilis muscles were then removed. It was typically at this level that the injectate was visible. Upon abduction of the leg, the large, white sciatic nerve was visible. At this point in the dissection a millimeter ruler was placed in proximity of the sciatic nerve, a digital picture was taken, and an assessment placement accuracy was made by the SRNA using the above noted scale (Figure 8).

Figure 8.

<u>Proximity of Niagra Blue Tainted Solute to Sciatic Nerve</u>.

After an accuracy assessment had been made, the other leg was prepared for injection as stated above. After an injection and dissection had been made on both legs, the rat was returned to a plastic bag and placed in a freezer to be disposed of by the post-graduate student s study protocol.

Data Analysis

Of interesting note, the first injection was very successful, scoring a five of seven on the accuracy scale (see Figure 9). Yet, when subsequent attempts were made without change to technique, the success rate declined to two and three after four attempts. It was at this point that the student reviewed Greene s rat anatomy text and reassessed previously dissected rats. The student made a change in technique that included pulling the leg in multiple directions while palpating the trochanter of the femur. It was noted by the student that this method appeared to isolate a more precise injection area.

Upon making this discovery, the fifth attempt was made. A score of six on the seven point scale was made, followed by scores of four through seven until the fourteenth attempt. An aberrant score of one was made in this series of attempts. It is not fully understood why this aberrant placement was made. It was noted that the anatomical window between the trochanter and the tail was more difficult to assess secondary to a less flexible leg when moving it in all directions. Two additional attempts were made with poorer scores of two and three.

At this point, fifteen attempts had been made. Improvements in accuracy were realized with reassessments of anatomical landmarks, reviewing Greene s anatomical atlas, and reviewing previously dissected rats.

Interestingly, a presumed gradual improvement in accuracy had not been realized at this point. Sporadic success with accuracy scores ranging from one through six on the seven-point scale were observed.

Additional reassessments of anatomy proved to enhance successful placement of the solute. Three rats with accurately noted injections were placed on the table for comparison. At this point all injection sites were noted, accuracy of injectate placement again observed, and all trochanters were palpated.

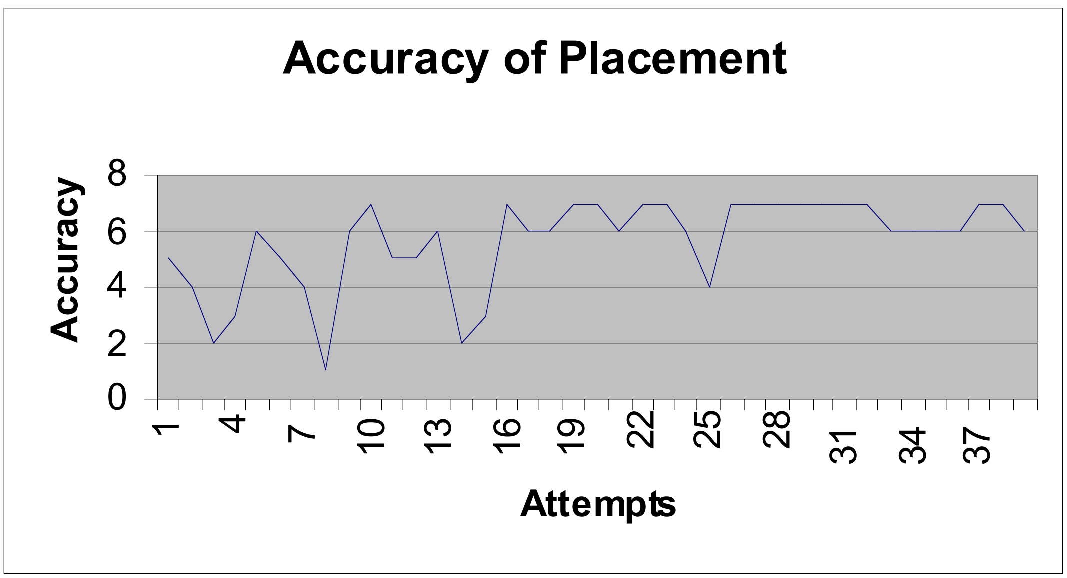

Figure 9.

<u>Graphic Depiction of Data Collection</u>.

It was noted that if the needle was placed 3mm superior of the previously assessed appropriate injection site and directed cephalad, a probable increase in accuracy would be realized. Additionally, it was noted that if the needle was placed on the trochanter itself

and walked medially toward the tail, the injection should be made after loss of resistance is felt.

It was also realized that sporadic success had been realized early in the study. It was not until a series of adjustments had been made that the higher scores of accuracy were obtained. Once these adjustments were made, the anticipated plateau of accuracy was realized.

This final assessment proved to be the answer to successful placement. The next 24 placements received scores of six and seven on the accuracy scale. One aberrant score of five was made for the same reason as the previous aberrant score, namely poorer flexibility of the leg.

Primary Data Analysis

Regardless of the success and failures noted above, it was realized that the most difficult assessment to be made for injection was regarding the depth of needle placement. Possibly unique to rat anatomy, a large open space is noted between the tail, the trochanter, and the deeper structures that include the sciatic nerve. It was difficult to assess to what depth the needle should be placed, especially when accounting for variations in anatomy from rat to rat.

The purpose of this pilot study was to assess how many attempts are required of a SRNA to become proficient with sciatic nerve blockade placement on a rat. Noting the outcome of this study, it would appear that approximately fifteen attempts would need to be attempted before a level of proficiency is obtained.

It was anticipated that a gradual improvement in accuracy would be made in placing the solute until proficiency was obtained. For example, scores of two and three were anticipated early on, followed by improved scores until sustained scores of six and seven were obtained.

The observations of this study revealed that adjustments to initial techniques needed to be made in order to obtain a level of proficiency. The anticipated assessment tools required for proper assessment were provided. Greene s classic text on rat anatomy had been studied and reviewed. Training had been provided by a knowledgeable neuroanatomist experienced with rat anatomy. Additionally, an initial dissection was made in order to actually visualize all anatomical structures involved, as well as providing a visual representation of superficial and deeper structures. Interestingly, with all these tools placed in my hands, several adjustments to initial techniques had to be made in order to obtain a level of proficiency. Once obtained, a sustained level of performance was observed.

The aberrant scores should not be dismissed as unimportant in this study. The lack of flexibility of the rat s leg, which possibly resulted in the aberrant scores, is a genuine concern. When faced with the possibility of transferring this information to a human model, the lack of flexibility on the part of a patient is a genuine concern.

The theoretical framework based on McAuliffe s (1993) model for advanced nursing practice was validated in this study. Her second theme, or Multiple Representation, stated that it is imperative that a student is exposed to multiple representations of a particular topic that is developed from different vantage points. As

stated, it was not until multiple assessments had been made, making changes to the initial technique, that a level of proficiency was obtained.

Of final note, all data collection did not transpire on one day. Logistical delays necessitated the need for multiple days of data collection. Ironically, this illuminated the fact that it is probably unrealistic in any clinical program to attempt thirty to forty sciatic nerve blocks in a time frame of less than several weeks to months. This unplanned delay in data collection did not appear to influence the learning curve. Earlier used techniques were carried into the next set of data collection. However, it was noted that with each delay it was necessary to reassess the rat anatomy and review the rat anatomy text before attempting additional injections. These reviews were done in order to optimize success.

CHAPTER V : SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

Conclusions

After receiving initial training from the neuroanatomist familiar with rat anatomy, reviewing a detailed rat anatomy text, and completing a careful dissection of a rat s sciatic nerve, it takes approximately fifteen attempts before a SRNA reaches a proficient level of competency in providing rat sciatic nerve blockade.

Dissections were begun within minutes of solute placement. Longer soak times may have influenced the proximity of solute to the sciatic nerve.

Early attempts at sciatic nerve location were sporadic at best after receiving the above noted training. When only utilizing anatomical landmarks as the assessment tool to sciatic nerve location, I was unable to obtain a level of sustained proficiency without continued reassessment of techniques used, and reviewing available resources. Only after re-evaluation of baseline knowledge through atlas texts, and a review of previously learned material, can a level of proficiency be obtained. As stated in McAuliffe s (1993) theoretical study, multiple attempts from different vantage points are needed in order to obtain a level of competence and proficiency.

If a student experiences long time lapses between attempts, a subjective need for re-evaluation occurs. This need to reassess one s baseline skill level seems appropriate.

Implications

It is unrealistic to presume that an anesthesia resident, somewhat familiar with anatomical landmarks, will regularly achieve success in neural blockade without first receiving instruction regarding specific regional blockade techniques.

Regardless of training received, sporadic success in early attempts of regional blockade on a human could be disastrous. Placement of local anesthetics in the proper location, without eliciting paresthesia or locating the nerve using a PNS, will probably result in an inadequate block. Additionally, protracted searching for the nerve is painful. Even if the block is successful, the patient will probably refuse regional blockade in the future secondary to an unpleasant experience.

In most clinical settings, sciatic nerve blockade will be used infrequently. There may be a necessity to review anatomical texts, review descriptive explanations on sciatic nerve blockade, and consult with other practitioners more familiar with neural blockade. The practitioner needs to also understand their limitations, and when the possibility of providing a successful blockade is poor, other techniques may need to be considered.

Recommendations for Further Study

The information gathered from this pilot study has provided much of the groundwork needed to pursue further study. In this pilot study, post-mortem rats were used in order to assess not only the learning curve of a SRNA locating a sciatic nerve, but rat anatomy with regards to location of the sciatic nerve.

A possible future study might necessitate the use of live rats. All blocks could be done on an anesthetized rat. This study might assess needle damage to nerves when attempting to place a sciatic nerve blockade, with and without a local anesthetic.

Another study with anesthetized rats might include the assessment of sensory and motor blockade of the sciatic nerve after a local anesthetic had been placed.

A bench study, followed by a human clinical study needs to be undertaken to compare the efficacy of utilizing a PNS, or anatomical landmarks alone. A determination might be made in discovering which technique is more efficacious in teaching newly trained anesthesia residents proper sciatic nerve blockade. This study might consider other regional blockade techniques.

A clinical bridge needs to be made to a human model. The potential for deleterious results in practicing on a human are apparent with the new resident. A strictly supervised resident providing sciatic nerve blockade in a controlled setting would be invaluable to influencing the didactic and clinical experience of a newly trained anesthesia resident. With multiple successful attempts, a level of proficiency is obtained by the resident.

Students are taught, learn, and ultimately released to the clinical setting to practice their trade. Without a proper introduction to, and understanding of the learning process, students will continue to experience frustration with failed blocks until a level of proficiency is obtained. The practice of regional anesthesia might be aborted for other familiar anesthetic techniques if the student has not obtained a level of proficiency in their training.

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APPENDICES

APPENDIX A

Time Line

In order to complete the major activities of this study and thesis submission, I determined the following milestones to establish a workable plan of action. After completion of the thesis proposal and submission to the Thesis Advisory Committee, the following plan was followed.

<u>Task List and Time Line for Research Project: Following Proposal Approval</u>

Task/Activity	Month 1 2 3 4 5 6 7 8 9 10 11 12
1. Obtain IRB Approval	--------
2. Collect Data	------------
3. Enter Data into	---------
4. Computer Analyze Data	--------
5. Prepare Draft Report	-------
6. Obtain Committee	--------
7. Review of Draft	
8. Prepare Final Draft	---------
9. Hold Thesis Defense	--------
10. Make Revisions as Needed	--------
11. Obtain Signatures of Committee Members	---------
12. Submit Thesis for Binding	--------

APPENDIX B

Data Collection

Count	Rat #	Left / Right	1-7 Ranking
	1	R	X
1	1	L	5
2	2	R	4
3	2	L	2
4	3	R	3
5	3	L	6
6	4	R	5
7	4	L	4
8	5	R	1
9	5	L	6
10	6	R	7
11	6	L	5
12	7	R	5
13	7	L	6
14	8	R	2
15	8	L	3
16	9	R	7
17	9	L	6
18	10	R	6
19	10	L	7
20	11	R	7
21	11	L	6
22	12	R	7
23	12	L	7
24	13	R	6
25	13	L	4
26	14	R	7
27	14	L	7
28	15	R	7
29	15	L	7
30	16	R	7
31	16	L	7
32	17	R	7
33	17	L	6
34	18	R	6
35	18	L	6
36	19	R	6
37	19	L	7
38	20	R	7
39	20	L	6

APPENDIX C

TISSUE SHARING MEMORANDUM

Laboratory Animal Review Board
Phone: (301) 295-3315
Fax: (301) 295-1964

April 13, 2000

MEMORANDUM FOR THE RECORD

SUBJECT: Tissue Sharing

On March 24, 2000, Dr. Donald Rigamonti requested to use tissue from 20 rats, obtained from Dr. John Sarvey, to teach/practice sciatic nerve blocking. This request was approved by Dr. Andrew Wilkinson, Acting Executive-Secretary, LARB. A memorandum outlining Dr. Rigamonti s request was attached to Dr. Wilkinson s biosamples protocol.

Nina Cisar
LARB Administrator
Department of Laboratory Animal Medicine